

Temperature Controller



Solution Guide

CE 🕼



Thank you very much for selecting Autonics products. For your safety, please read the corresponding product manuals before using them

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Preface

Thank you very much for selecting Autonics products.

Please familiarize yourself with the information in this manual and in the product manuals before using them.

This solution guide contains information about a specific architecture solution and does not replace any specific product documentation.

This document does not attempt to describe the entire solution architecture and configuration but only introduce some basics procedures. Customization of this solution can be made by the users in respect of safety laws and regulations.

Document Guide

- This manual provides procedure steps for a particular solution architecture. It does not offer any guarantee concerning matters beyond the scope of this manual.
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- The content of this manual may vary depending on updates of the product software and others unforeseen developments within Autonics. It is subject to change without prior notice. Upgrade notices are published through our homepage.
- We contrived to describe this manual the easiest and more accurate way. However, if there are any corrections required or questions, please notify us these remarks on our homepage.

Document Symbols

Symbol	Description
Note	Additional information about a particular feature.
Å Warning	Failure to follow instructions can result in serious injury or death.
A Caution	Failure to follow instructions can lead to a minor injury or product damage.
Ex.	An example of the concerned feature's use.
*1	Annotation mark.

Document Version History

Date	Version	Author	Description
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1 Solution Overview

1.1 Solution description

Autonics TM4 device from the TM series is a multi-channel PID temperature controller, capable of controlling various type of power controllers thanks to its build-in SSR driver or relay output and simultaneously controlling up to 4 elements, (up to 2 elements for the TM2 type). It has also build-in serial Modbus connection through RS-485 pins.

Thanks to its characteristic, the TM device can be added in any existing automation architecture with Modbus connection and device parameters or statuses, values limits and Present Value can be monitored or set, allowing remote access to key-data.



This solution brings the following benefits to your current installation:

- > Allows to monitor in real time several TM devices status and feedback values
- Allows settings of several TM devices parameters like setting values or PID parameters from only 1 device
- > Allows data exchange between different device types

4			
	Hardware / Software	Version	Note
	Ms Windows	Win 7	

1.2 Solution components and version

Ms Windows	Win 7	
TM4-N2RB		Autonics product.
XG-5000	v4.22	LS product. Release 2017.09.29
XBC-DN32H		LS product

1.3 Solution architecture



2 TM4 Communication Settings

Devices from the TM series do not have graphic interface; To change the devices' settings, we need to use the device management program from Autonics: DAQMaster.

1st Set the desired Modbus address thanks to the 'Communication address' switches, this address should be unique on the network:



2nd Connect the TM device to DAQMaster



Please follow the procedure in annex part of this document to connect a TM device to the DAQMaster program and have access to its parameters.

3rd In the DAQ Master 'Property' window, set the parameters of the 'Communication Setting' group as following:

Parameter	DAQ Master setting name	Value range	Note
Comm. speed	Baudrate	Multiple choice	User setting, same than the PLC parameter
Comm. Parity bit	Parity Bit	None	Fixed
Comm. Stop bit	Stop Bit	2	User setting
Comm. Response waiting time	Response waiting Time	20	User setting
Comm. writing	Communication Write	Enable	Fixed
Device address	Not available	1 to 31	User setting by switch dials, should be unique on the network

4th The TM temperature controller has been properly set.

3 XBC Project Settings

1st Run XG5000 and select [Project] – [New Project] in the menu bar. Enter project name and select CPU type 'XGB'-'XGB-XBCH' in the 'New Project' dialog box. Click 'OK'.

New Project		? <mark>- × -</mark>
P <u>r</u> oject name: File <u>d</u> irectory:	TM(XBC) C:\XG5000\TM(XBC)	OK Cancel
CPU Series	XGB Product Name	
<u>C</u> PU type:	XGB-XBCH 🔻	
Programming Format:	XGK Programming v	
Program name:	NewProgram	
Program <u>L</u> anguage:	LD v	
Project description:		

2nd Set connection method at [Online] – [Connection Settings]. This example is connection via USB, select connection type as 'USB' and click 'OK'.

С	onnectio	n Settin	igs - NewPL	с	_	? 🗙
	Connect	ion Setti	ings	_		
	<u>Type</u> :	USB		•	Setting:	s
	<u>D</u> epth:	Local	•	•	Pre <u>v</u> ie	w
	General					
	Timeout	<u>I</u> nterval	:	5	*	sec
	<u>R</u> etrial Ti	mes:		1		times
	Read / V	Vrite dat	ta size in PLC	runı	mode	
	© <u>N</u> o	rmal	Maximum	1		
	* Send	d maximu	um data size i	in sto	p mode.	
	Conne	ct	ОК		Ca	ncel

- 3rd Start connection at [Online] [Connect].
- 4th Under [Network Configuration] [Undefined Network] in the project tree, double-click on the 'NewPLC [B0S0 Internal Cnet]' device.



5th In 'Standard Settings - Cnet' dialog box appears. Set 'Standard Settings' tab as below.

ltem		Setting	Note
	Communication type	RS-485	Fixed
Standard	Communication speed	Same that TM	User setting
Channel 2	Terminating resistances	Disable	Fixed
	Station No.	Multiple choice	User setting, should be unique on the network
Operation mode	Channel 2	Use P2P	Mandatory

Standard Settings - Cnet		e
Standard Settings Adv	anced Settings	
Connection Settings	Channel 1	Channel 2
Type:	RS232C 👻	RS485 🔻
Speed:	9600 🔻	9600 👻
Terminating Resisters:	Disable 🔹	Disable 🔻
Station No.:	0	0
Operation Mode		
Channel 1: XGT serv	ver 🔻	Modbus Settings
Channel 2: Use P2P	•	Modbus Settings
Repeater Mode		
Setting Caution the Re	n: Communication serve peater mode.	vice is not supplied in
		OK Cancel

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6th In 'Advanced Settings' tab set as below, then click 'OK'.

ltem		Channel 2
	Data bit	8
Advanced settings	Stop bit	2
Ũ	Parity bit	NONE

ndard Settings Ad	vanced Settings	
Connection Settings	Channel 1	Channel 2
Data Bit:	8 🔻	8 🔹
Stop Bit:	1 •	2 🔹
Parity Bit:	NONE	
Parity Receiving	Disable 💌	Disable 🔻
Modem Type:	Null Modem 🔹	Null Modem 🔻
Modem Initialization:		
Time Settings		
Response Waiting Time: (0-50)(*100ms)	1	1
Delay Time Setting: (0-255)(*10ms)	0	2
Delay Time Between Character: (0-255)(*10ms)	1	1

7th In the project tree, right click on the 'NewPLC [B0S0 Internal Cnet]' device, and select [Add Item] – [P2P Communication]. Select '1' and click 'OK'

Project		▼ ₽ ×	NewProgram ×
▲ 靈 TM(XBC) * ▲ 靈 Network Configuration ▲ @ Undefined Network			
いい いっしょう System Variable	Open		
▲ m NewPLC(XGB-XBC	Add Item	÷	Network
Variable/Comm	Сору	Ctrl+C	Communication Module
Basic Param	Paste	Ctrl+V	P2P Communication
🔤 I/O Paramet 🗙	Delete	Delete	High-speed Link Communication
⊳[⊠] Internal Para ⊿∰ Scan Program	Properties		User Frame Add a Group
	Communication N	lodule Setting 🔷 🕨	Add Slave

8th In the project tree, double click on the newly created 'P2P Channel' under communication module – [P2P 01].



9th Set the 'P2P Driver' of the channel 2 to 'Modbus RTU client' and click 'OK'.

Channel Setting											
	Chann	Operation Mode	P2P Driver	TCP/UDP	Client/Server	Partner Port	Partner IP address				
	1	XGT server									
	2	Use P2P	*								
			User frame definition XGT client LS Bus Client Modhus ASCII client Modbus RTU client								

10th The project has been properly set. Then you need to create your own 'P2P block' depending on the desired point in the TM device and your own PLC program and download the complete project to the XBC device by selecting [Online] – [Write], then clicking 'OK'.



Please refer to the XG5000 documentation for procedures on Ladder program creation and other method to write project to a XBC device.

Please refer to the TM documentation for the complete list of Modbus registers and information on Modbus functions.

4 Data Exchange Example

4.1 Solution overview

4.1.1 Communication objective

In this example, we will access the TM registers from the XBC PLC to:

➤ Read:

- The present values measured by the temperature controller for CH1 and CH2
- The unit settings for CH1 and CH2

➤ Write:

- The setting values of the temperature controller for CH1 and CH2
- The activation flag of the Auto-Tuning function for CH1 and CH2

Point description		TM4		XBC		
Variable name	Read / Write function	Bit	Word	Bit	Word	
Present Value CH1	Read	-	0x303E8	-	D110	
PV unit CH1	Read		0x303EA		D111	
Present Value CH2	Read	-	0x303EE	-	D112	
PV unit CH2	Read		0x303F0	-	D113	
Setting Value CH1	Write	-	0x40000	-	D114	
Auto-Tuning CH1	Write	-	0x40064	-	D115	
Setting Value CH2	Write	-	0x403E8	-	D116	
Auto-Tuning CH2	Write	-	0x4044C	-	D117	

4.1.2 TM4 – XBC connection

In this example, we will set the communication address:

- of the XBC device to 0

- of the TM4 device to 1

4.2 XG5000 program

4.2.1 P2P Block definition

We will define 1 P2P block for each value that we want to transfer following the previously table, and associate a specific conditionnal action flag to the different elements (for read or write).

1st In the project tree, double click on 'P2P Block' under communication module - [P2P 01].



2nd Set the different table elements for the first line as following:

Item	Setting	Note		
Ch	2	XBC Channel number		
Driver Setting	Mod. RTU Clt	fixed		
P2P function	READ	Read or Write function		
Conditional flag	M10	Flag to trigger the communication		
Command type	1. Single	Select 2. if want to read several word registers in 1 command		
No. of variables	1	fixed		
Data size		Enter value if read several word registers in 1 command		
Destination station	Enable	To define Modbus ID		
Destination station number	1	Modbus ID of the targeted device		

	Ne	wProgr	am X NewPLC - P2P 01 X											
I	ndex	Ch	Driver Setting	P2P function	Conditional flag	Command type	Data type	No. of variables	Data size	Destin ation station	Destination station number	Frame	Setting	Variable setting contents
	0	2	Modbus RTU client	READ	M00010	1. Single	WORD	1		v	1		Setting	
	1												Setting	
	2												Setting	
	0			1	1	1		1		1			C - N	

3rd Click on 'Setting' button and set as following, then click 'OK'.

Item	Setting	Note
Read area	0x303E8	TM register to read/write data
Save area	D110	XBC register to save/read data
Address	Auto filled	Fixed by XG5000

Variable Setting									
Opponent PLC Detail Settings									
Oppone Series:	nt CPU	-	View by Product						
Opponent CPU									
Read area Save area	a: Remote Address 1: Local Address (Ne	wPLC)							
Read area Save area	a: Remote Address :: Local Address (Ne Read area	wPLC) Save area	Address						
Read area Save area	a: Remote Address 1: Local Address (Ne Read area 0x303E8	wPLC) Save area D00110	Address N00001						

4th Set the other table elements as following:

N	ewProgra	am 💉 NewPLC - P2P 01 🗙											
Index	Ch	Driver Setting	P2P function	Conditional flag	Command type	Data type	No. of variables	Data size	Destin ation station	Destination station number	Frame	Setting	Variable setting contents
0	2	Modbus RTU client	READ	M00010	1. Single	WORD	1		•	1		Setting	Number:1 READ1:0x303E8,SAVE1:D00110
1	2	Modbus RTU client	READ	M00011	1. Single	WORD	1		~	1		Setting	Number:1 READ1:0x303EA,SAVE1:D00111
2	2	Modbus RTU client	READ	M00012	1. Single	WORD	1		•	1		Setting	Number:1 READ1:0x303EE,SAVE1:D00112
3	2	Modbus RTU client	READ	M00013	1. Single	WORD	1		~	1		Setting	Number:1 READ1:0x303F0,SAVE1:D00113
4	2	Modbus RTU client	WRITE	M00014	1. Single	WORD	1		~	1		Setting	Number:1 READ1:D00114,SAVE1:0x40000
5	2	Modbus RTU client	WRITE	M00015	1. Single	WORD	1		~	1		Setting	Number:1 READ1:D00115,SAVE1:0x40064
6	2	Modbus RTU client	WRITE	M00016	1. Single	WORD	1		~	1		Setting	Number:1 READ1:D00116,SAVE1:0x403E8
7	2	Modbus RTU client	WRITE	M00017	1. Single	WORD	1		•	1		Setting	Number:1 READ1:D00117,SAVE1:0x4044C
0											[Sotting	

4.2.2 Ladder program

1st Create the following ladder program:

To set and monitor values:

Comment	//*******Overwriting/Mor //Use of mov functions to	nitoring of TM4 values o monitor and change variable values when in PLC monitoring mode				
Comment	//****TM4 device Modbu	is address 1				
Comment	//**Monitor values					
				31000	31000	Present Value CH1
	_ON		MOV	D0110	M110	0x303E8 (WORD)
3				0	0	
			MOV	D0111	M111	V Unit CH1 0x303EA (WORD)
<u> </u>	• • • • • • • • • • • • • • • • • • • •			24	24	B
			MOV	D0112	M112	0x303EE (WORD)
<u> </u>	• • • • • • • • • • • • • • • • • • • •			0	0	
			MOV	D0113	M113	(WORD)
Comment	//**Write values					
				80	80	SV CH1 0x40000
	_ON		MOV	M114	D0114	(WORD)
17	· · · · · · · · · · · · · · · · · · ·			0	0	Auto Turcino CUII
			MOV	M115	D0115	0x40064 (WORD)
	• • • • • • • • • • • • • • • • • • • •			25	25	SV CH2 0-402E9
			MOV	M116	D0116	(WORD)
				0	0	AutoTurcing CH2
			MOV	M117	D0117	0x4044C (WORD)

To manage reading flags:

Comment	//******Start V	Write/Read flag	gs management					
Comment	//****Reading I // Each flags a // Reading loop	Mode: ire becoming ac p can be pause	ctive one by one ed by a writing a	each 100ms ction				
	T100MC	140200				4		Activation loop for Read
32					 CTR	C000	5	action flags
		4						
	=	C000	1				M0010	associated to M10
37		4	·····'					
		C000	2				M0011	Counter = 2: action associated to M11
41	Η	0000	~ F		 		- $()-$	1
		4					M0012	Counter = 3: action
45	- =	C000	3					associated to M12
		4						Counter = 4: action
40	_ =	C000	4				MU013	associated to M13

To manage writing flags:





We will not describe how to create a Ladder program under XG 5000 in this document. Please refer to the XG 5000 documentation for more information.

2nd The project has been properly created, we need then to download the complete project to the XBC device by selecting [Online] – [Write], then clicking 'OK'.

4.3 Data exchange test

- > Set the CH1 and CH2 SV (M0114=D114=0x40000 and M0116=D116=0x403E8):
- 1st Double click on the 'M0114' variable in the '//write values' section, set to desired CH1 SV and click 'OK':

			23	23	Present Value CH1
		MOV	D00110	M0110	0x303E8 (WORD)
			0		PV Unit CH1 0x303EA
		MOV	D00111	M0111	(WORD)
	Change Current Value ? 🗙		23	23	
	Name: M0114	MOV	D00112	M0112	0x303EE (WORD)
	Type: WORD		0	0	
	Range: (0 ~ 65535)	MOV	D00113	M0113	(WORD)
Comment //**Write values					
	Display type: Unsigned		0	0	
_ON	Set value	MOV	M0114	D00114	SV CH1 0x40000 (WORD)
<u>17</u>	Value: 30			0	
	OK Cancel	MOV	M0115	D00115	AutoTuning CH1 0x40064 (WORD)
			0	0	SV CH2 0x403E8

- 2nd Set the same way the CH2 SV (M116).
- 3rd In the '//****Writing Mode' section, double click on the variable associated to the CH1 SV writing flag: 'M0204', set to 'TRUE' and click 'OK':

Comment	//****Writing Mode: // Each flags are becoming acti	Change Current Value	?	×		
54	// Writing action paused the rea M00204 M00205 	Name: M00204 Type: BIT Range:(0 ~ 1)			 M00209	
60	M00204	Display type: Unsigned Set value Value: 1 (TRUE) 0 (FA	LSE)		M00014 () _P2P1_ND _R04	*** Writing flag for SV CH1 reset flag after response received from
63		Forced I/OV OK	Cance	el	M00204	device

- 4th Using the same process, write the new CH2 SV value to the TM device (M0206).
 - Activate the CH1 Auto-Tuning function (M0115=D115=0x40064 = 1):
- 5th In the '//write values' section, double click on the 'M0115' variable, set to '1' to start the function or '0' to stop it, and click 'OK':

ON					Present Value CH1
		MOV	D00110	M0110	0x303E8 (WORD)
			0	0	PV/LIN# CH1 0v202EA
		MOV	D00111	M0111	(WORD)
	Change Current Value ? ×		23	23	Present Value CH2
	Namo: M0115	MOV	D00112	M0112	0x303EE (WORD)
			0	0	
	Bapper (0 + 65525)	MOV	D00113	M0113	(WORD)
	Kange. (0 * 03333)				
Comment //**Write values					
	Display type: Unsigned		30	30	SV/CH1 0-40000
_ON	Set value	MOV	M0114	D00114	(WORD)
17	Value: 1		0	0	
		MOV	M0115	D00115	AutoTuning CH1 0x40064 (WORD)
	OK Cancel		0	0	
		MOV	M0116	D00116	SV CH2 0x403E8

6th In the '//****Writing Mode' section, double click on the variable associated to the CH1 AT function writing flag: 'M0205', set to 'TRUE' and click 'OK':

60	M00204 	Change Current Value ? X Name: M00205 Type: BIT Range: (0 ~ 1)	M00014 	*** Writing flag for SV CH1 reset flag after response received from device
67		Display type: Unsigned Set value Value: 1 (TRUF) 0 (FALSE)	M00015	*** Writing flag for AutoTuning CH1
70		Forced I/OV OK Cancel	ND R05 M00205 R	reset tlag after response received from device

- Result for a temperature controller set to 'Heat' mode:
 - The CH1 or/and CH2 LED indicator will turn on if PV is lower than SV.
 - The CH1 or/and CH2 LED indicator will flash with 1 sec period if the Auto Tuning function has been activated.

5 Appendix

5.1 TM device connection to DAQ Master

There are severals ways to connect a TM device to the DAQ Master software:

- using the PC loader port of the TM device and the USB port of the PC
- using serial connection RS-485 of the TM device and the RS-232 port of the PC
- using serial connection RS-485 of the TM device and the USB port of the PC.



For each configuration, the procedure under DAQ Master is the same:

1st Start DAQ Master and select TM4 device (or TM2 depending of your model) under [Support Device List] - [AUTONICS] in the left tab menu.



2nd Select the 'RS-232' DAQ interface and click 'OK'.

ΤM	4 - DAQ Inter	face				×
N	ew DAQ Inte	erface	Added [OAQ Interface		
	RS-232					
	TCP/IP					
				ОК	Cance	1

3rd Once the communication interface has been created, select this RS-232 interface in the 'My System' menu and set the PC communication port connected to the TM device. Then the different communication settings can be configure to match the TM device settings.

Item	Setting	Note
Communication Port	Port name	Port number which is connected to TM device
Baudrate	Comm. speed	Actual TM baudrate can be determine by TM light indicator (see below). Fixed to 9600 if using SCM-US cable
Check Parity	None (default) / Odd / Even	Need to try different settings
Stop bit	1 / 2 (default)	Need to try different settings
Bit Per Byte	8	Fixed



Property		
R5-232		unTir
E General		nes
Name	RS-232	cre
Information] 🖺
Configuration		
Search Port List	Auto Search	•
Communication Port	COM3=VCP0	
Baudrate	9600	
Check Parity	None	•
Stop Bit	2	•
Bit Per Byte	8	•
Hardware	None	
Software	None	•
DTR Control	Disable	
RTS Flow Control	Disable	•
Byte Time	0	_



When power is supplied initially, 1 LED indicator associated to specific communication speed will fash for 5 sec; The device communication speed can be determine following this tables:

•	тι	M2	Se	ries	-
-			-00	1100	,

Status Indicator	Initial power ON ^{※1}
PWR (green) ^{**3}	ON
CH1 (red)	Flash (2,400bps)
CH2 (red)	Flash (4,800bps)
AL1 (yellow)	Flash (9,600bps)
AL2 (yellow)	Flash (19,200bps)
AL3	Flash (38,400bps)
AL4	_

Initial power ON^{*1}
ON
Flash (2,400bps)
Flash (4,800bps)
Flash (9,600bps)
Flash (19,200bps)
Flash (38,400bps)

4th Once the communication settings have been set, start the communication interface by clicking the 'Connect' button in the [Project] - [Run] menu from the icon bar.



5th Then find your TM device by doing a right-click on the TM4 icon in the 'My System' archictecture tree and select 'Scan Unit Address...'. Click on 'Start Scan', select your TM device when the search is done and click 'OK'.

Note

- search time can be reduced by changing searching range according to your device setting
- if using the SCM-US cable, all addresses can be used; set the range to 1~1.

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1	Scan Ur	nit - T	MA						28
	Scan	loit -							23
		Addre	ss Range 1	· · 1	-	Retry	0	•	Start Scan
	Scan S	tatus		1					
	Scanne	ed Uni	t	1		Other So	canned Unit	:	0
	No.	Add	ress Model	Ver	sion	No. /	Address	Model	Version
	V	1	TM4-N2RE	SW:	330, HW:100				
My Syst	tem 2000				×				
Ade	4 r	Del	Change	View -					
Name			Address	Status					
B RS-	232		COM3	Connected					
⊨ M	odBus M	laster	RTU, 3, 1	Connected					
L	TN	14	AUTONICS	(0) EA					
			Del Add						
			Scan Unit Addres	5					OK Cancel
			Read All Unit Para Copy Parameters	imeters					
			Print Modbus Ma Edit I/O Script	p Table					

6th Your TM device has been added to the system list. To have access to its parameters, click right on the device in the 'My System' architecture and select 'Read All Parameters'.

When the synchronisation has been done, you can access and customize your device parameters in the 'Property' window at the left side of DAQ Master.

My System		4 x
Add Del	Change	View -
Name	Address	Status
■ R5-232	COM3	Connected
🖮 ModBus Master	RTU, 3, 1	Connected
🗖 🎆 ТМ4	AUTONICS	(1) EA
L 1	TM4-N2RB	Connected
	Del Change	2
	Parame User Gro	ter Mask Settings oup Settings
	Read Al	l Parameters
	Save Pa Connec	rameter Values t



6 Troubleshooting



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Any proposal for a product improvement and development: Product@autonics.com

Dimensions or specifications on this manual are subject to change and some models may be discontinued without notice.

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